Answers

Chapter 1 – Set Theory

Lesson 1.1, page 14

1. **a)** Yes

b) e.g.,

- C = {produce}
- O = {orange produce} = {oranges, carrots}
- Y = {yellow produce} = {bananas, pineapples, corn}
- G = {green produce} = {apples, peas, beans}
- B = {brown produce} = {potatoes, pears}

c) e.g., $S \subset F$ because all fruits you can eat without peeling are also fruits. $S \subset C$ because all fruits you can eat without peeling are also produce.

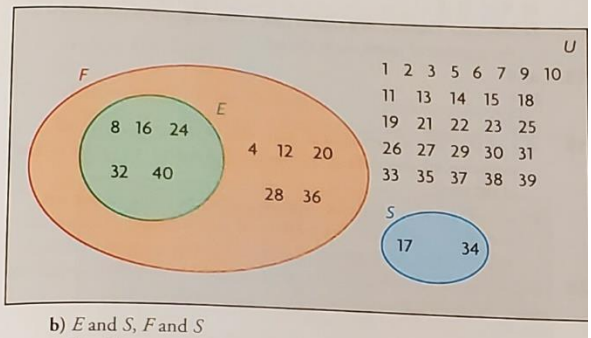
d) S and V, F and V

e) Yes. e.g., C = {F and V}, so $F' = V$.

f) $n(V) = 5$

g) oranges, pineapples, bananas, peas, carrots, corn, beans, potatoes

2. **a)**



b) E and S, F and S

c) **i)** True. e.g., Multiples of 8 are also multiples of 4.

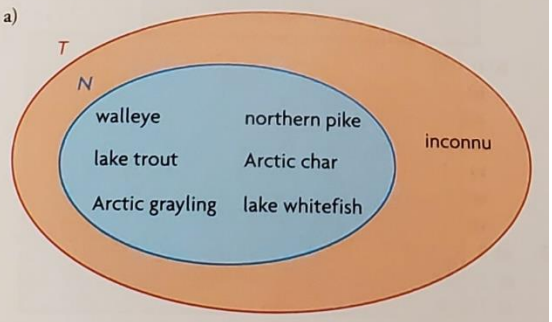
ii) False. e.g., Not all multiples of 4 are multiples of 8.

iii) True. e.g., All multiples of 8 are multiples of 8.

iv) False. e.g., F' = {all numbers from 1 to 40 that are not multiples of 4}

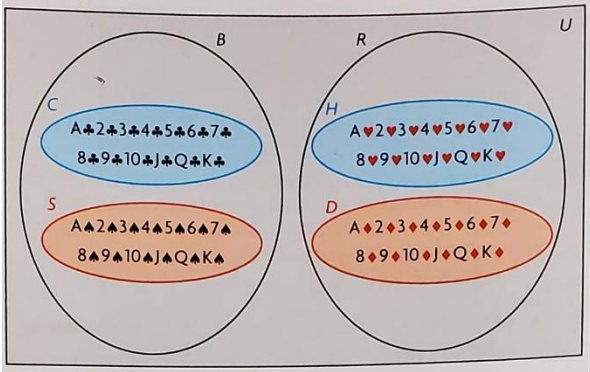
v) True. e.g., The universal set includes natural numbers from 1 to 40.

3. **a)**



b) e.g., $N \subset T$ means that all the fish found in Nunavut are also found in the Northwest Territories. $T \not\subset N$ means that not all the fish found in the Northwest Territories are found in Nunavut.

4. **a)**



b) C and S

c) H and D

d) Yes. e.g., A card cannot be both a spade and a club.

e) Yes. e.g., You cannot draw a card that is a heart and a diamond at the same time.

f) Yes. e.g., $n(S \text{ or } D) = 26$ (there are 26 cards that are spades or diamonds) = the number of cards that are spades (13) plus the number of cards that are diamonds (13) $= n(S) + n(D)$.

5. **a)** e.g., C = {all clothes}, S = {summer clothes}, W = {winter clothes}, H = {summer headgear}

b) C

c) No. e.g., S' includes jacket, but W does not.

d) S and W, H and W

e) e.g., C = {clothes}, H = {headgear} = {cap, sunglasses, toque}, B = {clothing for body} = {shirt, shorts, coat, jacket}, F = {footwear} = {sandals, insulated boots}

6. 99 988

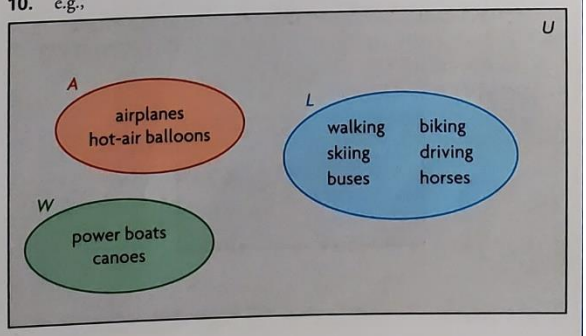
7. not possible; e.g., There may be some elements that are in both X and Y.

8. 76

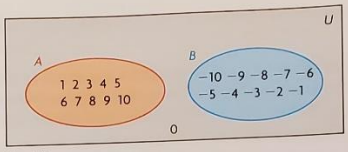
9. **a)** S = {A, E, F, H, I, K, L, M, N, T, V, W, X, Y, Z}
C = {C, O, S}

b) False. e.g., B is not in S or C.

10. e.g.,



11. a)



b) A and B

c) **i)** False. e.g., 1 is not in B.
ii) False. e.g., -1 is not in A.
iii) False. e.g., 0 is in A' but not in B.
iv) True. e.g., $n(A) = 10$, $n(B) = 10$
v) True. e.g., No integer from -20 to -15 is in U.

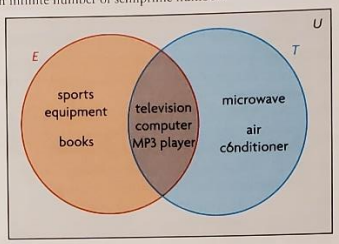
12. a) $S = \{4, 6, 9, 10, 14, 15, 21, 22, 25, 26, 33, 34, 35, 38, 39, 46, 49\}$
$W = \{1, 2, 3, 5, 7, 8, 11, 12, 13, 16, 17, 18, 19, 20, 23, 24, 27, 28, 29, 30, 31, 32, 36, 37, 40, 41, 42, 43, 44, 45, 47, 48, 50\}$

b) e.g., $E = \{\text{even semiprime numbers}\}$
$E = \{4, 6, 10, 14, 22, 26, 34, 38, 46\}$

c) 33

d) No. e.g., There is an infinite number of prime numbers, so there is an infinite number of semiprime numbers.

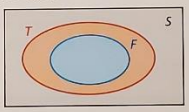
13. e.g.,



14. e.g., Agree. The number of elements in a subset must be equal to or less than the number of elements in the set.

15. a) $S = \{x \mid -1000 \le x \le 1000, x \in \mathrm{I}\}$
$T = \{t \mid t = 25x, -40 \le x \le 40, x \in \mathrm{I}\}$
$F = \{f \mid f = 50x, -20 \le x \le 20, x \in \mathrm{I}\}$
$F \subset T \subset S$

b)

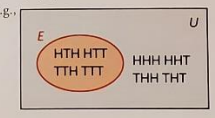


16. a) $U = \{\text{HHH, HHT, HTH, THH, HTT, THT, TTH, TTT}\}$

b) $E = \{\text{HTH, HTT, TTH, TTT}\}$

c) $n(U) = 8$; $n(E) = 4$

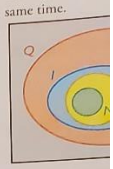
d) Yes. e.g.,



e) e.g., E' is the set o
heads; $n(E') = n($
$E' = \{\text{HHH, HH}$

f) Yes. e.g., A coin ca
same time.

17. a)



b) e.g., N' is the set
all non-whole nu
Q' is the set of nu
integers. Q' is the
two integers.

c) N and Q, W and

d) Yes. e.g., Q' is th
ratio of two integ

e) W, I, Q, R

f) No. e.g., The are
the number of el

18. a) 8

b) 9

c) 283

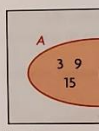
19. a) e.g., $A \subset B$ if all
weekdays are also
of the week.

b) e.g., A' consists
in A. For exampl
weekend days. S

20. e.g., Disagree; since
same elements and

Lesson 1.2, page

1. a)



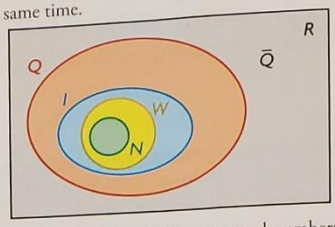
b) **i)** 5
ii) 3
iii) 7
iv) 5
v) 2
vi) 10
vii) 5

2. a) 8
b) 11; 6
c) 19; 14
d) 25
e) 13

e) e.g., E' is the set of elements of U where the second coin turns up heads; $n(E') = n(U) - n(E) = 8 - 4 = 4$;
$E' = \{HHH, HHT, THH, THT\}$

f) Yes. e.g., A coin cannot show both heads and tails at the same time.

17. a)



b) e.g., N' is the set of all non-natural numbers. W' is the set of all non-whole numbers. I' is the set of non-integer numbers. Q' is the set of numbers that cannot be described as a ratio of two integers. $\overline{Q}'$ is the set of numbers that can be described as a ratio of two integers.

c) N and $\overline{Q}$, W and $\overline{Q}$, I and $\overline{Q}$, Q and $\overline{Q}$

d) Yes. e.g., Q' is the set of numbers that cannot be described as a ratio of two integers, which is the set of irrational numbers.

e) W, I, Q, R

f) No. e.g., The area of a region in a Venn diagram is not related to the number of elements in the set.

18. a) 8

b) 9

c) 283

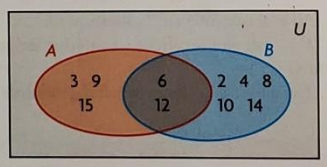
19. a) e.g., $A \subset B$ if all elements of A are also in B. For example, all weekdays are also days of the week, so weekdays is a subset of days of the week.

b) e.g., A' consists of all the elements in the universal set but not in A. For example, all days of the week that are not weekdays are weekend days. So weekend days is the complement of weekdays.

20. e.g., Disagree; since both the subsets are empty, they both contain the same elements and are therefore the same subset.

Lesson 1.2, page 20

1. a)



b) i) 5

ii) 3

iii) 7

iv) 5

v) 2

vi) 10

vii) 5

2. a) 8

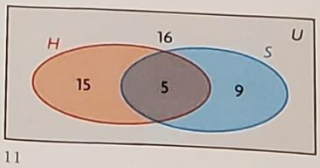
b) 11; 6

c) 19; 14

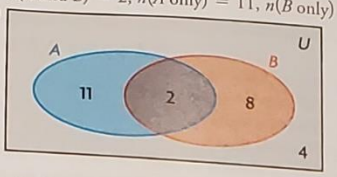
d) 25

e) 13

3. a) 5
   b) 24
   c)



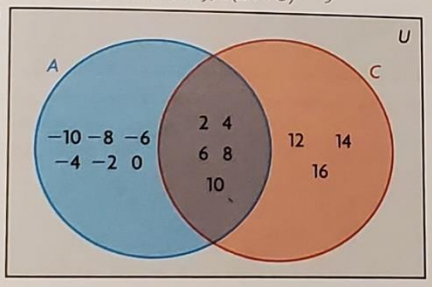
4. a) 11
   b) 14
   c) 21
5. a) $n(A \text{ and } B) = 2$, $n(A \text{ only}) = 11$, $n(B \text{ only}) = 8$
   b)



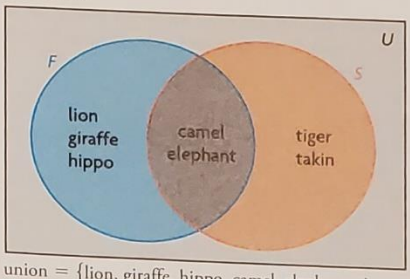
Lesson 1.3, page 32

1. a) $\{-10, -8, -6, -4, -2, 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$
   b) 16
   c) $\{0, 2, 4, 6, 8, 10\}$
   d) 6
2. a) union = {Arctic fox, caribou, ermine, muskox, polar bear, grizzly bear, bald eagle, Canadian lynx, grey wolf, long-eared ow wolverine}
   intersection = {grizzly bear}
   b)

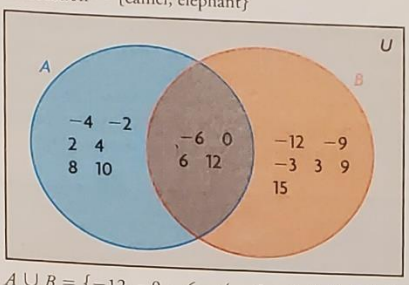
3. a) $A \cup C = \{-10, -8, -6, -4, -2, 0, 2, 4, 6, 8, 10, 12, 14, 1$
   $n(A \cup C) = 14$
   $A \cap C = \{2, 4, 6, 8, 10\}$; $n(A \cap C) = 5$
   b)



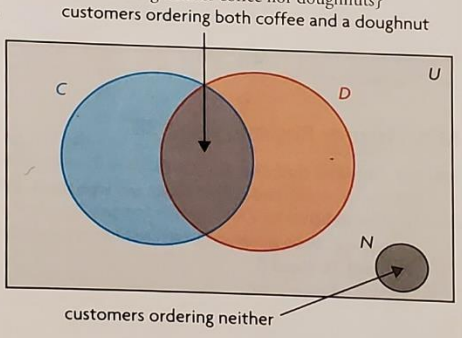
4. a) {half-tons, quarter-tons, vans, SUVs, crossovers, 4-door sedans, 2-door coupes, sports cars, hybrids}
   b) 9
   c) {crossovers}
5. a)



   b) union = {lion, giraffe, hippo, camel, elephant, tiger, takin}
   intersection = {camel, elephant}
6. a)

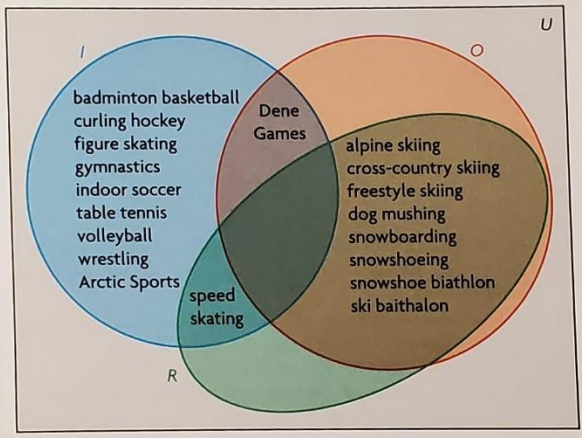


   b) $A \cup B = \{-12, -9, -6, -4, -3, -2, 0, 2, 3, 4, 6, 8, 9, 10, 12, 15\}$; $n(A \cup B) = 16$
   $A \cap B = \{-6, 0, 6, 12\}$; $n(A \cap B) = 4$
7. 6; 10; 5
8. 40
9. 12
10. e.g., She could draw a Venn diagram showing the set of multiples of 2 and the set of multiples of 3. The intersection of the sets would be the multiples of 6.
11. a) U = {all customers surveyed}, C = {customers ordering coffee}, D = {customers ordering doughnuts}, N = {customers ordering neither coffee nor doughnuts}
    b) e.g.,



    c) 20

12. 33
13. 10
14. 16
15. 6
16. No. e.g., Some students take a bus but do not drive a car. So these regions should only be partially overlapping. The total number of students in Beyondé's diagram is only 43.
17. **a)** A and B
    b) A and C
    c) Yes; B and C; e.g., C intersecting A and A and B being disjoint says nothing about the intersection, if any, of B and C.
18. e.g., The union of two sets is more like the addition of two numbers because all the elements of each set are counted together, instead of just those present in both sets.
19. **a)** e.g., indoor, outdoor, races
    b) e.g., U = {all sports}, I = {indoor sports} = {badminton, basketball, curling, figure skating, gymnastics, hockey, indoor soccer, speed skating, table tennis, volleyball, wrestling, Arctic Sports, Dene Games}, O = {outdoor sports} = {alpine skiing, cross-country skiing, freestyle skiing, snowshoe biathlon, ski biathlon, dog mushing, snowboarding, snowshoeing, Dene Games}, R = {races} = {speed skating, alpine skiing, cross-country skiing, biathlon, dog mushing, snowboarding, snowshoeing}
    c) e.g.,

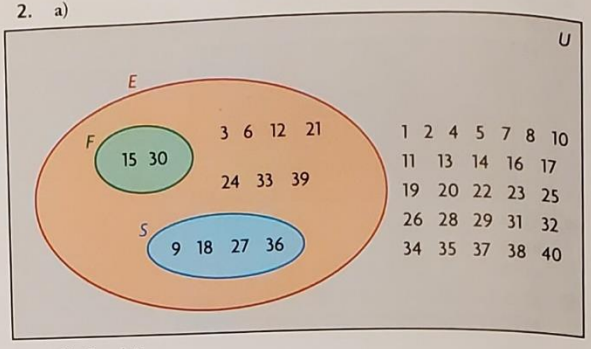


    d) Yes

Mid-Chapter Review, page 38

1. **a)** $V \subset N$, $M \subset N$, $F \subset N$, $F \subset M$
   b) e.g., N = {all foods}, V = {fruits and vegetables}, M = {meats}, F = {fish}
   c) No. e.g., Pasta is not part of M or V.
   d) V and M, V and F

2. a)



b) S and F

c) **i)** False. e.g., 6 is in E but not in F.

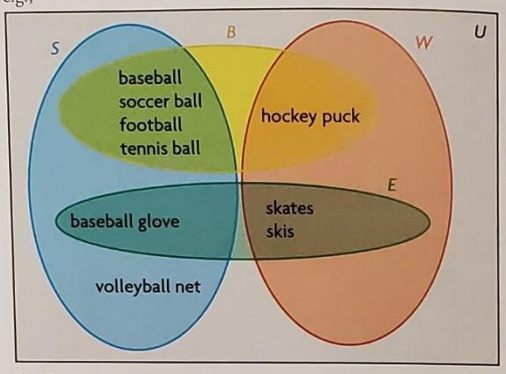
ii) True. e.g., All elements in S are in E.

iii) False. e.g., 9 is not a multiple of 15.

iv) True. e.g., $F = \{15, 30\}$

v) True. e.g., A set is a subset of itself.

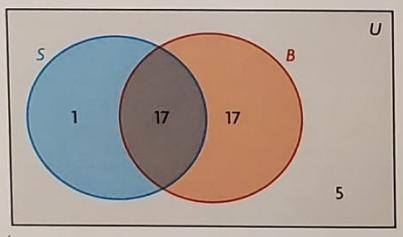
3. e.g.,



4. **a)** 17

b) 18

c)



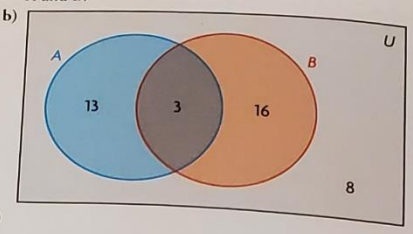
5. **a)** 4

b) 9

c) 2

6. a) e.g., Tanya did not put any elements in the intersection of A and B.

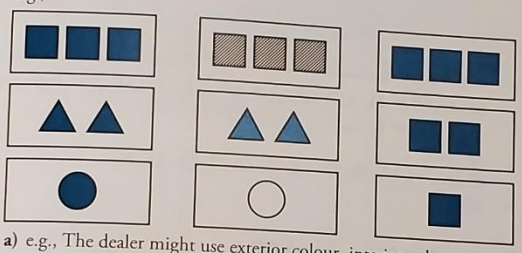
b)



7. 0

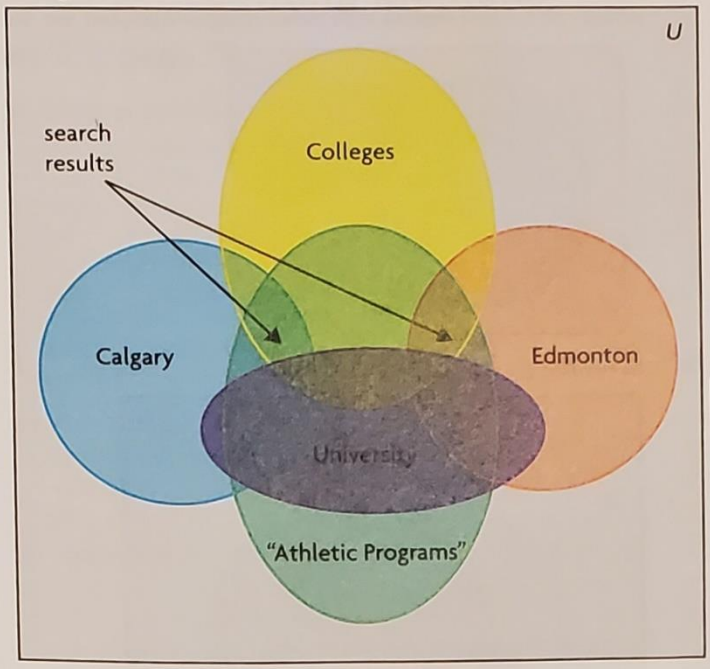
Lesson 1.4, page 51

1. e.g., $p = 14$, $q = 9$, $r = 12$
2. a) 32 b) 27 c) 63 d) 7
3. e.g., Staff could look at how many David Smiths were on that bus route or they could look at the books in the bag and see how many David Smiths are taking courses that use those books.
4. C = {contact lens wearers}, G = {glasses wearers}; $n(C \cap G) = 51$ or about 10.8%
5. e.g., "Canadian Rockies," "ski accommodations," "weather forecast," "Whistler." By combining two or more of these terms, Jacques can search for the intersection of web pages related to these terms. For example, "ski accommodations" and "Canadian Rockies" is more likely to give him useful information for his trip than either of those terms on its own.
6. 7
7. e.g.,



8. a) e.g., The dealer might use exterior colour, interior colour, or year.
   b) e.g., The dealer might prioritize the search according to options Travis wants or by distance from where Travis lives.
9. e.g., He counted the students who like two of the three restaurants and undercounted those that like all three. 63
10. a) e.g., He can search for *colleges and* (*Calgary or Edmonton*).
    b) "and"
    c) "or"
    d) e.g., *colleges and* (*Calgary or Edmonton*) *and "athletics programs"-university*
    e) e.g., about 1500

f) e.g.,



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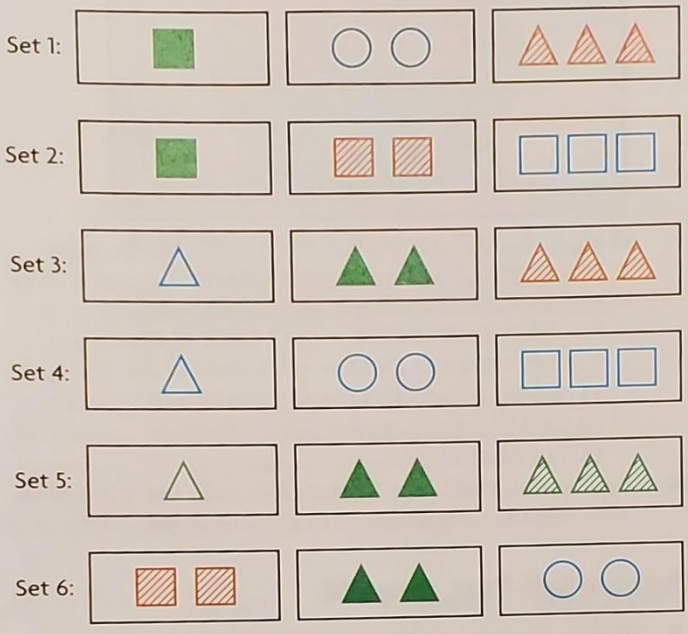


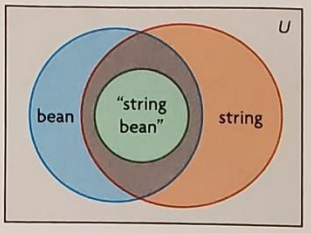
12. **a)** 81 **b)** 27 **c)** 27 **d)** 54 **e)** 45 **f)** 18

13. **a)** 36; e.g., 35 sites deal with boats. 21 sites deal with fishing. Of those 21 sites, 20 also deal with boats, so only 1 site deals with just fishing.

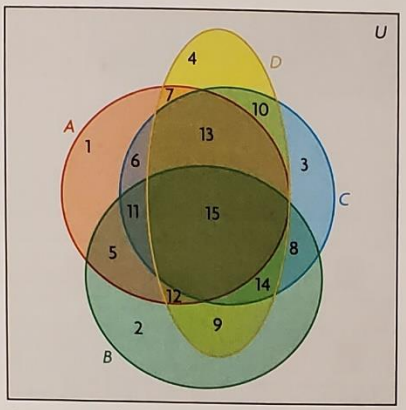
b) e.g., Because *fishing* and *boats* will turn up sites that deal with boats and fishing, but not just fishing boats.

c) 1

14. e.g., No, they did not get the same results. Elinor got all of James' results, plus others dealing with either *string* or *bean*, but not both.



15. **a)** and **b)** e.g.,



c) e.g., $1 = A\backslash(B \cup C \cup D)$; $2 = B\backslash(A \cup C \cup D)$;
$3 = C\backslash(A \cup B \cup D)$; $4 = D\backslash(A \cup B \cup C)$;
$5 = (A \cap B)\backslash(C \cup D)$; $6 = (A \cap C)\backslash(B \cup D)$;
$7 = (A \cap D)\backslash(B \cup C)$; $8 = (B \cap C)\backslash(A \cup D)$;
$9 = (B \cap D)\backslash(A \cup C)$; $10 = (C \cap D)\backslash(A \cup B)$;
$11 = (A \cap B \cap C)\backslash D$; $12 = (A \cap B \cap D)\backslash C$;
$13 = (A \cap C \cap D)\backslash B$; $14 = (B \cap C \cap D)\backslash A$;
$15 = A \cap B \cap C \cap D$

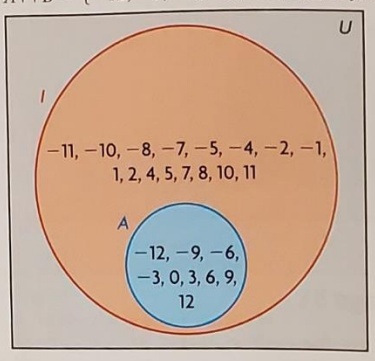
16. e.g., Let B = {blue}, Y = {yellow}, R = {red}, and G = {green}. There is no area representing $(B \cap R)\backslash(G \cup Y)$ or $(G \cap Y)\backslash(B \cup R)$.

Chapter Self-Test, page 56

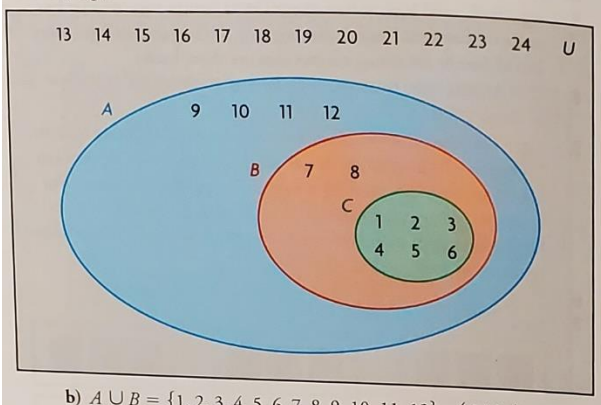
1. **a)** {Eric Ashdown, Art Napoleon, Don Amero, Lucie Idlout}
b) {Terry-Lynn Williams Davidson, Art Napoleon, Don Amero, Lucie Idlout}
c) {Art Napoleon, Don Amero, Lucie Idlout}
d) {Eric Ashdown}

2. **a)** $A \cup B = \{-12, -11, -10, -9, -8, -7, -6, -5, -4, -3, -2, -1, 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12\}$; $n(A \cup B) = 25$;
$A \cap B = \{-12, -9, -6, -3, 0, 3, 6, 9, 12\}$; $n(A \cap B) = 9$

b)



3. **a)** e.g.,



b) $A \cup B = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12\}$; $n(A \cup B) = 12$;
$A \cap C = \{1, 2, 3, 4, 5, 6\}$; $n(A \cap C) = 6$

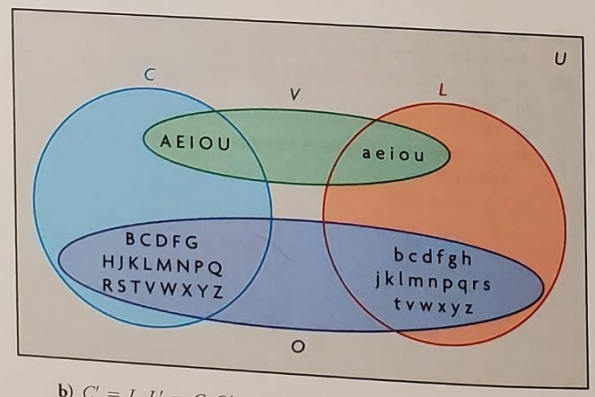
c) $\{7, 8\}$

d) $\{13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24\}$

4. 8%

Chapter Review, page 58

1. **a)** e.g.,

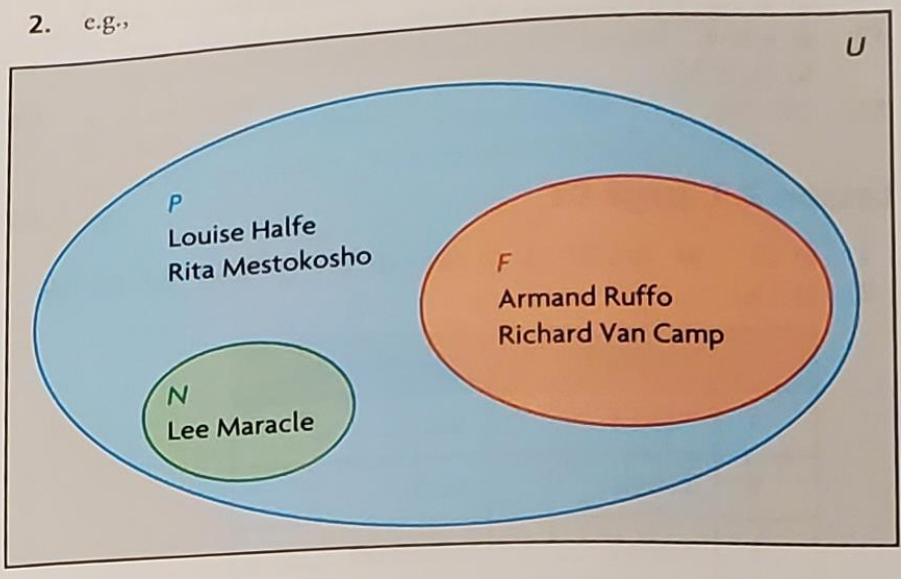


b) $C' = L, L' = C, O' = V, V' = O$

c) C and L, O and V

d) No

2. e.g.,



3. 56

4. **a)** 8; e.g., Of the 19 students with black hair, 8 have blue eyes.

b) 11

c) 0

5. 64

6. 1

7. 104

8.